A Survey Paper on Channel Estimation Schemes in OFDM System

Bittu Pandey[#1], Ajay Kumar Barapatre[*2]

[#]*Research Scholar,*Asst. Prof. & Department of Electronics Communication Engineering*
Vedica Institute of Technology, RKDF University Bhopal(MP) India

[1]Bittubaba576@gmail.com

[2] barapatre.ajay@yahoo.co.in

Abstract—*Because of the benefits of optical fibre, data transfer speeds and propagation distances can be increased. OFDM is utilized in hybrid optical-wi-fi gadget designs as a multicarrier technique (MC) as it has the best spectrum performance to radio frequency (RF) interruption and decrease multipath distortion. OFDM (orthogonal frequency department multiplexing) is a sort of multi-provider transmission era that employs OFD).It employs digital signal processing (DSP) to perform an inverse Fast Fourier transform (IFFT)and assemble a sequence of orthogonal sub-carriers for information transmissions of low rate virtual signals, permitting the switch of high-speed information bits. Its brilliant spectrum performance and anti-dispersion abilities make it perfect for a huge variety of high-potential and long-distance optical fibre verbal exchange utility structures and optical get right of entry to networks.*

Keywords— ***OFDM, DSP, IFFT,MC,RF***

I. Introduction

OFDM, (Orthogonal Frequency Division Multiplexing) is a multicarrier virtual modulation method that developed along DSP technology. OFDM alerts have stepped forward spectral performance and Because they are orthogonal in both the time and frequency domains, they provide better anti-multipath interruption satisfaction than other multi-carrier multiplexing structures. With each the assist of DSP processors, OFDM signals may be without difficulty created and demodulated. Equalization of the channels and different operations also are pretty straightforward. As a result, OFDM is broadly utilized in wireless, wireline, and broadcast communications. Because OFDM is a multi-carrier transmission system,

It can be divided into two categories: modulation technology and multiplexing technology. The same principle underpins OFDM as it does frequency division multiplexing (FDM). It employs digital signal processing to generate a series of orthogonal sub-carriers that allow for the simultaneous transmission of low-rate digital signals, enabling for the transmission of high-speed digital communications.

The influence of chromatic dispersion and polarization mode dispersion (PMD) on optical fiber links on communications networks is ruled not only by the function of the optical transmitter and receiver, but also with the influence of chromatic dispersion and polarization mode dispersion (PMD). The data rate of single channel transmission in optical communication has increased significantly with the evolution of communication technology and the improvement efforts of system requirement, reaching 100 Gb/s. But even so, when the data rate exceeds 100 Gb/s, basic optical fiber modification has become prohibitively expensive and time-consuming.and effective dispersion compensation becomes impossible.

Because of OFDM's improved computational properties, complex frequency-domain operations can be performed. OFDM technology, particularly optical OFDM, is thought That since scattering of optical fibres, it has been used in optical communication. can be effectively regulated (O-OFDM). This approach can improve resistance to optical fibre chromatic dispersion and PMD. This paper introduces the fundamental principle of O-OFDM. The fundamental concept of O-OFDM is introduced in this paper. The second section discusses the use of OFDM in optical communication networks. Finally, the issues with O-OFDM are discussed, and also potential solutions. remedies.

II. The Principle of O-OFDM

The O-OFDM principle is the same as the OFDM principle. The signal is converted from an electrical domain wireless signal to an optical domain optical signal as the only difference. Figure 1 depicts the O-OFDM system's architecture block arrangement.

OFDM baseband transmission, RF up-conversion, and optical modulation are all included in the transmitter. Optical detection, RF down-conversion, and OFDM baseband receipt are all part of the receiver. The S/P transformation at the transmitter translates the binary serial digital signal into N-channel parallel data. M-ary PSK or QAM is used to modulate each byte of information. A array diagram is used to translate the signal to the appropriate complex domain. IFFT is then used to convert the N parallel carriers to serial ones, and an OFDM symbol is introduced beside each sign. After trying to insert the cyclic prefix (CP), the signal is digital-to-analog transformed to an OFDM baseband analogue signal.

The baseband signal is converted to the RF carrier frequency and then to the optical carrier frequency without first being transmitted via single mode fibre (SMF). The DSP inside the receiver is basically the inverse of the DSP with in transmitter. A detector (PD) converts the optical signal to energy signal, which is then converted into numerical domain by an analog-to-digital converter (ADC).

III. Application of OFDM in Optical Communication

Indentation is required for all paragraphs. All sentences must be justified on both the left and right sides, which means on both sides.

Direct detection O-OFDM(DDO-OFDM) System

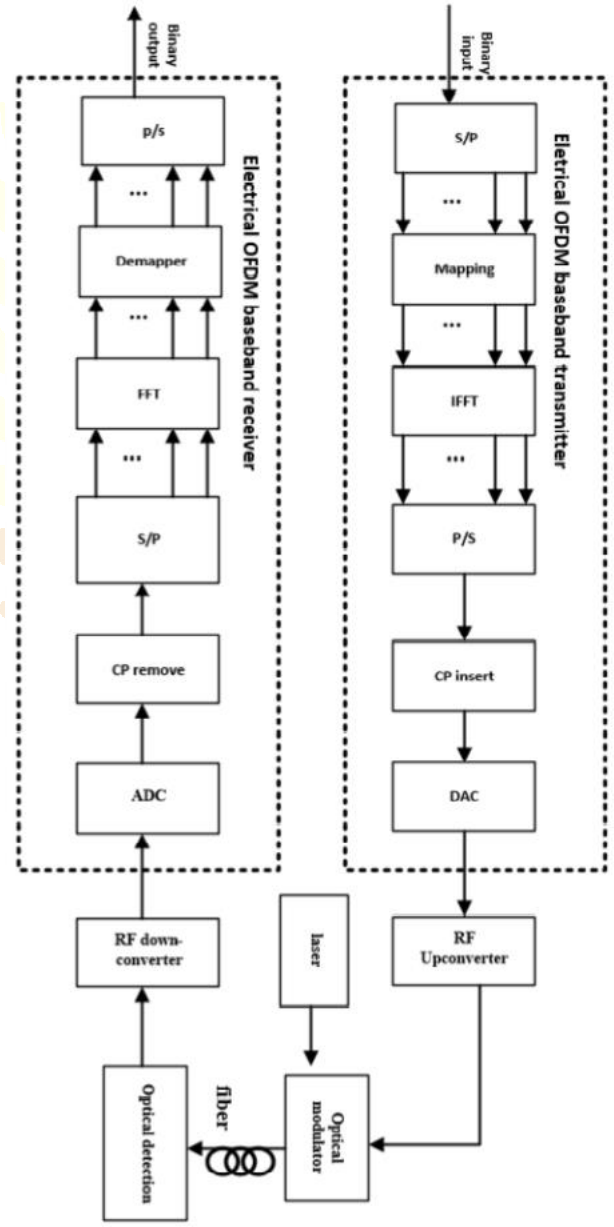

FIG 1:-Structure diagram of O-OFDM system

Figure 1 depicts the structure of a DDO-OFDM system. DDO-OFDM systems are classified into two groups based on the methods used to create O-OFDM signals. direct access to the OFDM optical spectrum In a linear mapping DDO-OFDM system, the frequency of optical OFDM is the linear transfer of baseband OFDM spectrum, meaning that duplication is direct.

The dispersion coefficient influences the transmission distance in this system, so accounting for it in the electrical or optical domains is critical. Furthermore, because the number of subcarriers influences the DDO-OFDM system, it must be carefully selected based on spectrum usage and BER requirements.

DDO-OFDM linear mapping is formally expressed as,

$$s(t)=e^{j2\pi f_0}+\alpha e^{j2\pi(f_0+\triangle f)r}\cdot s_B(t) \qquad (1)$$

In formula (1), f_0 is the frequency of the optical carrier; Δf is the protection bandwidth between the optical primary carrier and the OFDM band; s(t) is an optical OFDM signal; and is a proportional coefficient regarding the relation between the energy of the OFDM band and the primary carrier. SB (t) is a given baseband OFDM signal that can be written as:

$$s_B(t)=\sum_{k=-\frac{1}{2}N+1}^{\frac{1}{2}N} C_K e^{j2\pi f_k r} \qquad (2)$$

The information symbols and frequencies of the k-th subcarrier are denoted by ck and fk, respectively.

The following is the direct assistance waveform in the non-linear mapping DDO-OFDM system:

$$E(t)=e^{j2\pi f_0 r}A(t)^{1+jc} \qquad (3)$$

$$A(t)=\sqrt{p(t)}=A_0\sqrt{1+\alpha \mathrm{Re}(e^{j(2\pi f_{IF}t)}\cdot s_B(t))} \qquad (4)$$

$$m=\alpha\sqrt{\sum_{K=-\frac{1}{2}N+1}^{\frac{1}{2}N}|c_k|^2} \qquad (5)$$

E(t) is the optical OFDM signal; A(t) and P(t) are the optical OFDM signal's instantaneous amplitude and power, respectively. C is the direct modulated DFB laser's chirp constant; fl(F) is the pulse width intermediary frequency of the electrical OFDM signal; m is the optical modulation index; and is the proportionality constant used to select the appropriate modulation index m to minimise the limiting vibration.

Because the DDO-OFDM channel model is no longer stable due to the interaction of optical dispersion factors, it is only suitable for short-range application areas such as multimode fibre (MMF) local area network (LAN) or short-range SMF transmission.

A. Coherent detection OFDM (CO-OFDM) system

Only the maximum insertion of light, not the sequence information, can be detected in a DDO-OFDM system. CO-OFDM, but in the other hand, has a very high detection sensitivity and can compensate for DDO-drawbacks, OFDM's allowing for long-distance transmission. The CO-OFDM system is depicted schematically in Figure 2. Similarly, the number of subcarriers has a direct impact on the CO-OFDM system's quality. If the number is too large, channel interference will occur.

Spectrum use will be lowered if the number is too small. As a result, keeping count of the information of subcarriers is critical. Furthermore, various modulation configurations in a COOFDM system would influence the optical signal-to-noise ratio (OSNR), nonlinear impact, and overall system performance and optical fibre dispersion tolerance, necessitating the involvement of qualified technical personnel. Choose a fair debugging mode after trying to balance communication range, transmission capacity, and debugging time. Bit error rate and spectrum utilisation It is important to note that the difference in differential group delay is significant. (DGD) has the potential to negatively impact system performance. As DGD increases, system performance improves; however, as DGD exceeds a certain threshold, system performance declines because The main factor influencing system performance is PMD (DGD), which can also be accelerated.

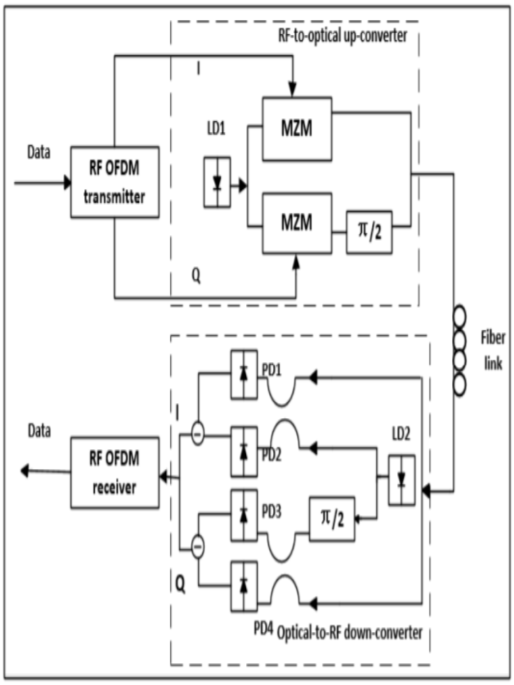

FIG 2:- coherent optical OFDM system

B. Application of OFDM in access network

In access networks, multiple services must be assigned to multiple customers at a time. Present EPON and GPON systems require complex task scheduling and framing approach will enable multiple services. Packet forwarding disruptions and other data traffic passing through that type of link have an impact on the performance of these TDM-PONs. Furthermore, because each service can use a longer wavelengths, WDM-PON can impartially allocate a variety of services. Polarization-dependent loss (PDL), PMD, and chromatic aberration all have an impact on signals.

To dissipate the wavelength to the relevant receivers, multiple transmitters and arrayed waveguide gratings (AWG) or optical filters may be needed, necessitating the use of multiple transmitters and arrayed waveguide gratings (AWG) or optical filters. Expenses and system costs are on the rise. Moreover, WDM-PON is incapable of rapidly allocating resources across multiple services. The use of OFDM advanced technologies in PON has the potential to significantly reduce the expense of WDM PON. Inputs are affected by isotropic lost opportunity (PDL), PMD, and chromatic aberration.

OFDMA, as a multi-access modern technology, can continuously disburse distinct subcarriers to various users in OFDM-PON, allowing for resource distribution in both the time domain and the frequency domain. It can support a variety of services transparently and adaptively allocate bandwidth to all of these applications. When combined with TDM-PON, OFDM-PON can provide extra resource management systems.

IV. LITERATURE REVIEW

The CO-OFDM system can effectively adjust and approximate PMD in optical fibres. To boost system capacity, polarisation division multiplexing (PDM) innovation must be presented into The CO-OFDM system not just to satisfy the requirement of the system for each component but also enhance transmission rate. As a result, the PDM CO-OFDM system has been identified as an important element of future ultra-high capacity, ultra-high speed, and ultra-long distance power transmission. PDL, PMD, and chromatic dispersion all have an impact on optical signal transmission in SMFs, which usually have two polarisation modes.

Title	Author Name	Year of Publication	Work Done
Time domain synchronous OFDM system foropticalfiber communications	C. Jing, X. Tang, X. Zhang, L. Xi and W. Zhang	2019	This research combines the features of QPSK OFDM and 16QAM OFDM systems in optical fiber communication. The proposed methodology has been demonstrated to have high CFO evaluation and sequential accuracy. A QPSK OFDM system has a BER of the less than 3.8e-3 at a 13-dB electro - optic signal-to-noise ratio (OSNR), while the 16-QAM OFDM system has a BER of less than 3.8e-3 at a 20-dB OSNR.

Analysis of DFT-Based Channel Estimation for Uplink Massive MIMO Systems	HaoWu,Member, YuanLiu,andKai Wang	2018	The impact of an extended Kalman filter transmission estimation method on a massive-MIMO system was illustrated. Whenever the SNR is low, this one has been revealed that non-allocating sub carriers to Zero padding lead to better results. The methodology utilizes the high speed Fourier transform/inverse high speed Fourier transform to torque for short complexity. This paper also investigates DFT-based modulation scheme for transceiver massive MIMO systems. The simulation results show the constraints of the proposed technique in low SNR AWGN channels. The best results are displayed using an improved Kalman filter with FFT system, that also immensely reduces computational complexities.
Of Channel State Information for Massive MIMOBased on Received Data Using Kalman Filter	AqielAlmamori,SeshadriMohan	2018	Channel state information (CSI) evaluation for sensing of input signal data was created using the Kalman Filter and basic experience of the channel or established pilot bits. The examinations conducted the OFDM-based QPSK modulation technique. A reconfigured Kalman filter is applied to the received data that can provide channel state information (CSI) and estimate channel noise. The result analysis of the enhanced Kalman filter is less dependent on the channel statistics and yields the minimum MSE.
Compressed sensing for wireless communications:useful tips and tricks	J.W.Choi,B.Shim, Y.Ding,B.Rao,and D.I.Kim	2017	Presented an overview of CS advanced technologies at a high level, such as basic configuration, the piecemeal recovery process, and performance assurance As a consequence, in various wireless communication systems, we describe three distinct CS sub-problems: vulnerability estimation, medium identification, and vulnerability detection. We also go over some of the most significant factors when building CS-based wireless communications systems. Which include the potential and constraints of CS strategies, beneficial recommendations to keep in mind, slight points to keep in mind, and several preliminary knowledge for performance improvement.
Near-optimal signal detector based on structured compressive sensing for massive SMMIMO	Z.Gao, L.Dai, C.Qi,C. Yuen,and Z.Wang	2017	A low complexity signal technique based on structured compression sensors (SCS) was recommended to significantly enhance detection accuracy. To create the necessary constructed economy, we first propose an integrated reporting categorised at the transmitter level in which discrete SM signals are categorised in distinctive constant frequency ranges to carry the symbol of the prevalent space cluster. As a consequence, a constructed subspace tracking technique (SSP algorithm) is recommended to the receiver in order to cohesively gather many SM signals using systematic scarcity.

V. CONCLUSION

We present a space time block code bandwidth index modulation scheme for transmitting over frequency selective routes that is based on CS-assisted low complexity detector in this paper. The information bits are transmitted using space, time, and bandwidth dimensions to enhance bandwidth efficiency and BER performance. The proposed methodology was using space space - time block coding in the simulated universe, which outperformed the conventional OFDM-STSK system in terms of BER. In terms of MSE efficiency, ANN channel estimation outperforms classic MMSE channel estimating techniques.

REFERENCES

[1] C. Jing, X. Tang, X. Zhang, L. Xi and W. Zhang, "Time domain synchronous OFDM system foroptical fiber communications," in China Communications, vol. 16,no. 9, pp.155-164, Sept. 2019.

[2] Hao Wu, Member, Yuan Liu, and Kai Wang, "*Analysis of DFT Based Channel Estimation for Uplink Massive MIMO Systems*",IEEE Communications Letters, Vol. 22, no.2,2018, pp. 328-331.

[3] Aqiel Almamori, Seshadri Mohan, "*Estimation of Channel State Information for Massive MIMO Based on Received Data Using Kalman Filter*" IEEE Computing and Communication Workshop and Conference(CCWC), 2018,pp. 665-669.

[4] J.W.Choi, B.Shim, Y.Ding, B.Rao, and D.I.Kim, "Compressed sensing for wireless communications: useful tips and tricks" IEEE Communications Surveys Tutorials, vol. PP, no.99, pp. 1–1,February,2017.

[5] Z.Gao, L.Dai, C.Qi, C.Yuen, and Z.Wang, "Near-optimal signal detector based on structured compressive sensing for massive SMMIMO," IEEE Transactionson Vehicular Technology, vol.66 ,no.2, pp.1860–1865,Feb 2017.

[6] Pham Hong Lien, Nguyen Due Quang and Luu Thanh Tra, "*Extended Kalman Filter for Channel and Carrier Frequency Offset Estimation*", International Conference on System Science and Engineering, 2017, pp.61-65.

[7] Ibrahim A. Hemadeh, Mohammed El-Hajjar, Seung Hwan Won, Lajos Hanzo, "Multi user steered multi set space-time shift keying for millimeter wave communications," IEEE Transactions on Vehicular Technology, vol.66, no.6, pp.5491–5495,June2017.

[8] Kalpesh Hiray, K. Vinoth Babu, "*A Neural Network Based Channel Estimation Scheme for OFDM System*", International Conference on Communication and Signal Processing, 2016, pp.438-441.

[9] H. Zhang, L.L. Yang, and L. Hanzo, "Compressed sensing g improves the performance of subcarrier index-modulation-assisted OFDM," IEEE Access, vol.4, pp. 7859–7873, October2016.

[10] I.A. Hemadeh, M. El-Hajjar, S. Won, and L. Hanzo, "Layer edmulti groups teered space-time shift-keying for millimeter-wave communications," IEEE Access, vol.4, pp. 3708–3718, April 2016.